Environmental Science at Beamline 10.3.2

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Themes: How are toxic elements sequestered in the environment?
How do living organisms deal with toxics?
What happens when a toxic site is remediated?

What we get from 10.3.2:
XRF mapping: Where is it? What other elements is it with?
EXAFS: What is its chemical form? What valence? What's it attached to?
XRD (new): What mineral is it with?

Unlocking Metal Sequestration in Soils

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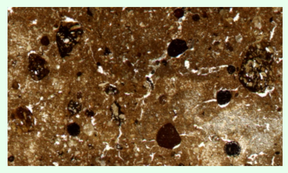
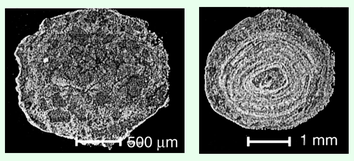
How are trace elements naturally sequestered in soils?
Ferromanganese nodules are common sinks.



Photomicrograph of a soil thin section containing ferromanganese nodules.



Typical back-scatter electron (BSE) images of soil micronodules.

Objectives

To determine quantitatively the forms of Zn and Ni in typical soil micronodules.

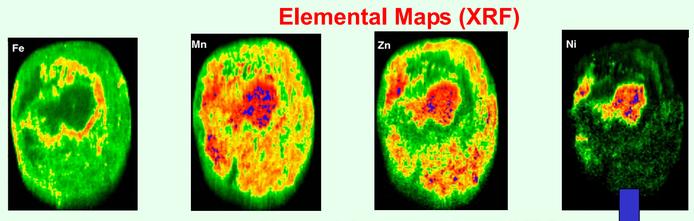
Ultimately, to compare sequestration mechanisms of trace metals from a variety of continental soils.

Approach

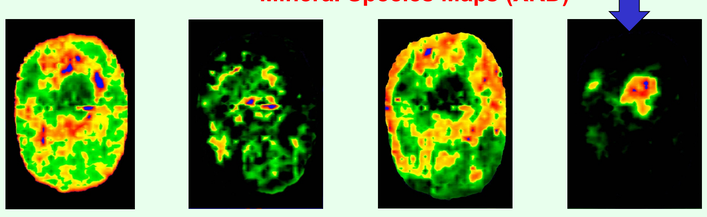
Synergistic use of three non-invasive synchrotron-based techniques:

- X-ray microfluorescence (SRXF)
- X-ray microdiffraction (XRD and SXRD)
- X-ray absorption spectroscopy (EXAFS and EXAFS)

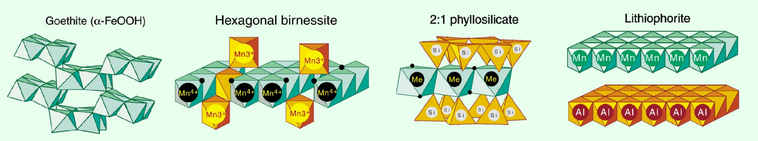
Elemental Maps (XRF)



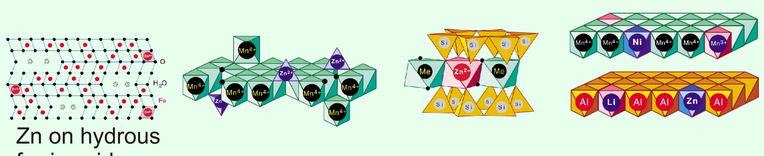
Mineral Species Maps (XRD)



Matrix minerals



Sequestered forms of metals (EXAFS)



Zn on hydrous ferric oxide

Zn | Zn | Zn | Zn,Ni

Conclude: In soil nodules, Ni occurs as 1 species (Ni-lithiophorite), Zn as several.